

First of a Series on  
SMALL LIVING THINGS

## SMALL LIVING THINGS--INTRODUCTION

*by*

EDITH FLEMING

*Raymond Foundation*



Museum Stories, Number 262

March 6, 1954

## Small Living Things

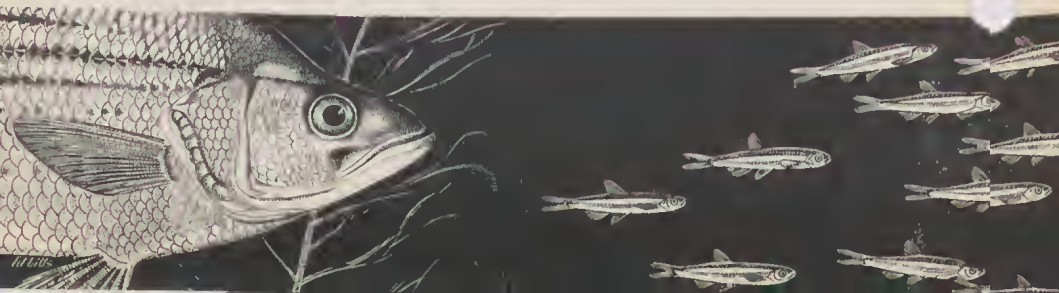
All of us are interested in stories of giants and pygmies. We like to hear about the biggest animal and the tallest tree, and we like to hear about the smallest things in the world as well.

Perhaps you have thought that only people could be pygmies. But there are other kinds of pygmies—pygmy birds and pygmy mammals. When there are large and small forms of the same kind of animal, the smallest form might be called a pygmy. This small size is inherited, and pygmy parents always have pygmy young. Some kinds of pygmies are tiny, while others are large. There is a pygmy rabbit that is small, of course, because rabbits are comparatively small animals, and there is a pygmy hippopotamus that is only half the size of the common hippopotamus, but it is very large in comparison with the rabbit. So, you see, the name pygmy means the smallest variety of its kind and not the smallest in the world.

The smallest living things in the world are so tiny that you cannot see them except through a microscope. In these stories you will read about small plants and small animals that you can see with your own eyes.

The smallest flowering plants, the duckweeds, grow in ponds, covering the surface with a floating green carpet. The plant is tiny, and you will need a microscope to see the minute flowers.

Long ago there were tiny one-celled animals called foraminifera, whose remains can be found in the rocks today because they were housed in tiny shells that became fossils. Their modern descendants are beautifully colored little creatures—pink, red, or yellowish brown—that live in the ocean all the way from the Arctic to the Antarctic. Though



you can see them, again you will need a microscope to study the interesting forms of their shells—circles, stars, clusters, and spirals.

Tiny things can be important. Sometimes we think of bigness as success. We talk of a big house or a big car. In the animal world there is another kind of success. The successful animal is one that can thrive in great numbers and varieties in the most varied habitats. Can you guess what animals are the most successful according to this standard? They are not the strongest animals nor the largest. They are the insects, which flourish in all climates from the Tropics to the Arctic. The insects, like the foraminifera, are small and do not have backbones, but they are many-celled and complex in structure, while the foraminifera are one-celled and simple.

There are also tiny animals with backbones: snakes that look like worms, and are called worm snakes, and pygmy shrews, the smallest mammals in North America. But you would have to travel to Cuba to find one of the smallest birds, Princess Helena's hummer. This little hummingbird is like a bright, glowing jewel and weighs no more than a ten-cent piece.

You have heard stories of giants and pygmies. There is no race of giant men, but there are real Pygmies living today in the jungles of Africa, the Philippines, and the Malay Peninsula. You are going to read more about these little people, little plants, and little animals in the seven stories that follow this one.



*This page is for your own notes and illustrations*

Second of a Series on  
SMALL LIVING THINGS

## DUCKWEEDS

*by*

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March 13, 1954

## Duckweeds

If you have an aquarium you can grow in it the world's tiniest flowering plants, the duckweeds. These plants may be found in almost every pond or slow-moving stream in most parts of the country. Even though ponds may be covered with duckweeds, very few people, even trained botanists, have seen their flowers. Duckweeds bloom rarely and briefly, and, when they do, the flowers are so small they can be seen only through a microscope.

Duckweeds are most important in wildlife conservation and management. Fishes and birds, especially ducks, relish this plant food, hence the name "duck-meat" or "duck-weed." Not only do duckweeds themselves provide food, but they also attract many insects and other animals that are a source of food for fishes and birds.

Duckweeds make up for their small size by their tremendous numbers and their remarkable powers of reproduction. A single duckweed may multiply to several millions in one season. A compact floating mat of the largest duckweed

may contain from 100,000 to 200,000 plants per square yard and of the tiniest duckweed, wolffia, from 1,000,000 to 2,000,000 plants per square yard. One pound of wolffia includes 4,500,000 plants. The remarkable power of the duckweeds to reproduce themselves is helpful. They can be introduced into ponds so contaminated with dead and decaying plant and animal matter that other plants cannot survive, and, in a surprisingly short time, the duckweeds, with the aid of sunlight, will purify the water so that other plants can grow.







WOLFFIA

enlarged  
12 times



COMMON DUCKWEED

enlarged  
2½ times



LARGE DUCKWEED

enlarged  
2½ times

Today the duckweeds are the most simplified of all flowering plants, having flattened or globe-like bodies without definite leaves or stems. The largest duckweed has several roots suspended from the bottom of the plant, the common duckweed has just one root, and the tiniest duckweed has no roots. Constantly turned over and over by wind and water currents, the duckweeds invariably pop right side up because of the tiny air chambers in the upper part of the plant body.

Toward the end of summer, when the days begin to get shorter, the young duckweed plants produce and store an increasing amount of starch. The plants that appear in the fall have smaller and smaller air chambers that make them less buoyant. Gradually the old plants die off, and their places are taken by the younger denser ones. Finally, late in the fall, the youngest plants become so heavy with starch that the whole mass sinks to the bottom, and there it remains throughout the winter. In this way the duckweeds escape the ice that covers the surface of the pond.

In the spring new plants begin to grow out of the sunken plants, using the stored starch for food. As they continue to grow, the starch supply becomes less and, eventually, the whole group of plants, parents and offspring alike, becomes lightened enough to rise to the surface where another season of growth and reproduction is begun. It takes very little time for new duckweed carpets to form, and once again the pond is covered with a floating green carpet of duckweeds, tiniest of flowering plants.

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Third of a Series on  
SMALL LIVING THINGS

# FORAMINIFERA—MINIATURE "SEA SHELLS"

by

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*Raymond Foundation*



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## Foraminifera—Miniature "Sea Shells"

What is the smallest animal with a shell in the world? The foraminifera (pronounced fo-ram-i-nif-er-ah) are among the smallest animals with shells, some of them being the size of a pinhead. But one kind that lives in tropical waters is the size of a dinner plate. Foraminifera belong to that group of animals called protozoans (first animals). They are also among the most numerous animals in the world, but you have probably never seen foraminifera because they are so small and usually live in the oceans. Some live on the bottom of the ocean and slowly crawl about searching for food. Other kinds live near the surface and spend their lives floating in whatever direction the ocean currents carry them. Countless millions of one kind, Globigerina, discard their shells in a never-ending snowfall that settles slowly to the ocean floor. These shells cover a third of the ocean bottom to an unknown depth.

Look at these tiny animals under a microscope and you will be amazed at their beautifully colored forms that resemble miniature sea shells. Some of them are pink, some are red, or white, or yellowish brown.

Each kind of foraminifera builds its own shape of a "test." It is called a test instead of a shell because of the different manner in which it is secreted. Imagine these tests as little houses that the animals build around themselves. Some of them build flat little houses that look just like coins. Others build houses the shape of a grain of wheat. Another kind has a house that looks like the shell of a snail but is much, much smaller. And still other foraminifera build houses with several tiny rooms that look like bubbles. They are quite fussy about their building materials. Some foraminifera prefer grains of sand that they carefully

FORAMINIFERA greatly enlarged but not to scale



cement together, others use flakes of mica, and still others secrete calcium carbonate or a horny substance called chitin to make their houses.

The little animal inside the test is a microscopic blob of a jelly-like substance called protoplasm. Through dozens of openings in its test, the foraminifera extends long, thread-like pseudopodia (false feet). The little animal waves the pseudopodia about in the water, using them as arms for swimming and to catch food such as tiny plants.

Foraminifera are among the oldest kinds of animals on earth. Their fossilized tests have been found in rocks of Cambrian age (540 million years old). If you were climbing Mount Everest, at the 22,000-foot level (four miles up) you would find a very thick layer of limestone containing fossil foraminifera. This layer of rock was formed millions of years ago as mud on the bottom of the ocean where these small animals lived. Much later these layers of rock were pushed up to form the Himalaya mountains, so that today mud that was once on the ocean floor is now a layer of rock in the world's highest mountain. Throughout the world there are many beds of chalk, limestone, and marble that were formed from innumerable tests of foraminifera that lived and died millions of years ago. The Great Pyramid of Egypt is made of limestone containing foraminifera named *Camerina*. *Camerinas* are about the size and shape of a quarter.

Oil geologists have been able to classify foraminifera and other microfossils according to the geologic age in which they lived. During the drilling of an oil well bits of rock containing foraminifera are brought to the surface. The oil geologist identifies these fossils to learn the age of the rock layer that the drill bit is passing through. With this information he is better able to judge the possibilities of finding oil.



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Fourth of a Series on  
SMALL LIVING THINGS

## MINIATURE INSECTS

*by*

HARRIET SMITH

*Raymond Foundation*



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March 27, 1954

## Miniature Insects

Insects are among the smallest animals we notice around us. Yet the small body of an insect contains a brain, heart, muscles, and other organs that function like those in the complicated body of an animal with a bony skeleton. Each kind of insect is equipped for living in a definite type of environment, and yet all of this special equipment is packed in such a small body that we must use a microscope to examine the structure of most insects. It's not that insects can't be bigger—the largest insect today is a foot-long walking stick of the tropics, and millions of years ago there were dragonflies with bodies two feet long. The wonder is that there can be complex creatures so very small, yet perfect in every detail.

There are even pygmy species in insect families too. Grasshoppers are generally quite big insects, just as people are one of the larger kinds of mammals. And, just as pygmy people are a group much smaller than the human average, so pygmy locusts are unexpectedly small members of the grasshopper family—only one-half inch long.

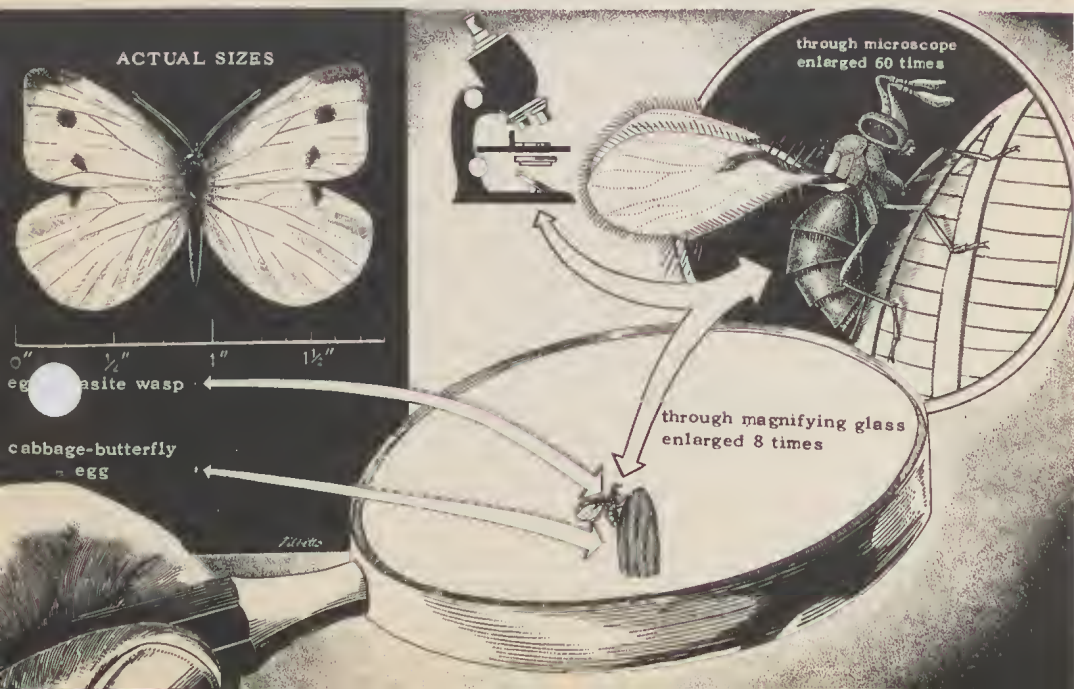
But a half inch is about medium size for an insect. Most of the thousands of species that have been discovered so far are less than one-half inch long, and many are so little that they look like a bit of moving dust to human eyes. Most flies, for instance, are rather small insects, and certainly the tiny biting gnat that Northwoods Indians call "no-see-um" is about as small as anyone can imagine. You feel its fiery bite first and, if you look very quickly, can just see what looks like a dot of black ash fly off from the burn it has started on your skin.

It would take a dozen of these tiny no-see-um flies lined up along your ruler to measure off an inch. But what may be the smallest insect in the world is a European wasp only one-tenth as big as a no-see-um. This is, of course, so very small that the sharpest human eyes still need the aid of a microscope to see it. However, living unnoticed all around us are many of its important cousins, over twice as big, which can just barely be seen. Even insect



specialists, who are used to miniatures, consider insects of which it takes fifty lined up endwise to measure off an inch really small, and they've named these the *minute* egg parasites. "Minute" (pronounced my-noot) means very tiny—"no bigger than a minute" (min-nut), though to you and me a fiftieth of an inch is split-second size.

Naturally, all the members of this family of wasps have to be extremely small since they all lay their eggs in the eggs of other insects, and it is this method of making sure of a food supply for their young that often makes them the farmers' partners. The minute species are particularly valuable to us because they so often select the eggs of butterflies and moths whose caterpillars are the saboteurs of our farm crops. The wasp larvae are parasites, hatching and growing inside the moth egg at the expense of the caterpillar, which dies before it can hatch and start damaging plants. In seven weeks three female wasps of one species had about 300,000 descendants, and so uncountable thousands may be living on a single farm. Since there are egg-parasite wasps in all parts of the world where our lumber trees and crops of grain, cotton, and fruit grow, we are very fortunate to have them on our side in man's world-wide struggle for food, shelter, and clothing.



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Fifth of a Series on  
SMALL LIVING THINGS

# SMALL FISHES, AMPHIBIANS, AND REPTILES

*by*

NANCY WORSHAM

*Raymond Foundation*



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April 3, 1954

## Small Fishes, Amphibians, and Reptiles

"I had 16,000 fishes for supper last night" sounds like quite a fish story, but if you lived on the island of Luzon in the Philippines it could be true. Lake Buhi is the home of more kinds of minute fishes than any other section of the world. The natives catch these little fishes and dry them in the sun. Compact masses or balls of this fish product are sold in the market for a few pennies or traded for a handful or two of rice or three or four potatoes. A one-pound fish cake contains about 16,000 fishes and is either boiled with fresh vegetables or fried in oil.

Many of these fishes are smaller than one inch, but the very smallest species is less than the length of the word "fishes" on this page—only three-eighths of an inch long. Its name, *Pandaka pygmaea*, translated into English means "dwarf pygmy." Since these fishes are colorless, nearly



transparent, and quite slender, their black eyes are all that can be easily seen as they swim, even in very clear water. These small fishes lay extremely tiny eggs, not as large as the period at the end of this sentence.

The smallest fish of the United States is a little toothed minnow or killifish from Florida. It is around twice the size of the dwarf pygmy but is not used for food. These little fishes are important to us in another way because they feed whenever possible on mosquito larvae. They,

along with other toothed minnows, have been "planted" in ponds, marshes, cisterns, and tanks to keep down the populations of these pests, which in turn helps control the diseases carried by mosquitoes.

Although the tiniest fishes are the smallest vertebrates, there are salamanders, frogs, snakes, and lizards notable for their small size. A little Mexican salamander, *thorius*, is about one and one-half inches long, including its tail. It burrows under the sod and, like most burrowing animals, is nearly blind. When these little salamanders are disturbed or frightened, they coil up tightly, like watch springs. Some people believe that the salamanders are trying to mimic snails in their shells.

Many frogs and toads are quite small when they first leave the water, but grow rapidly. Others, however, never get very large. The smallest is the Cuban dwarf frog. It is only three-eighths of an inch long when full grown, scarcely larger than a housefly. There are several other very small kinds, only slightly larger than the Cuban dwarf, living in the tropics of Africa, Asia, or America.

There is a group of small burrowing snakes called worm snakes because they are shaped and colored like common earthworms. Close inspection, however, shows that they actually have small hard scales, a few teeth, minute eyes, and, in some cases, a spine at the end of the tail. But even so, the head and tail are almost identical in appearance. Worm snakes vary in size from the thickness of a lead pencil to only slightly heavier than twine.

The smallest of all reptiles are members of the gecko family of lizards. The lizards are able to walk on the underside of leaves or on ceilings in search of flies and other insects because their toes are swollen at the ends to form hold-fast pads. All the warmer regions of the world have their own particular geckos. Panama is the home of the smallest gecko of all—only two inches long.

There are many small animals all over the world but, because of their small size, limited ranges, and secluded habits, they are not well known, as are the larger, more spectacular animals.

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Sixth of a Series on  
SMALL LIVING THINGS

## HUMMINGBIRDS

*by*

JEAN SHULTZ

*Raymond Foundation*



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April 10, 1954



## Hummingbirds

The hummingbirds include the smallest known birds. The many species vary in size, shape, and color like the flowers of the tropics where most of them make their homes.

These tiny birds get their name from the humming or buzzing sound made by their wings as they dart from flower to flower, hovering here and there like miniature helicopters, to get the sweet nectar and insects that they eat. The small wings of these birds move so rapidly that it is almost impossible to see them, and the birds are able to fly backward. Because the wings move so swiftly they must be controlled by very powerful wing muscles. Their feet are quite small, just large enough to support the tiny birds as they perch on a branch.

There are about three hundred species of hummingbirds and all live in the Western Hemisphere (the New World). Most of them are in South and Central America, but a few live as far north as the United States and Canada. The ruby-throated hummingbird is the only one regularly found east of the Mississippi River. While the ruby-throat is a small hummer compared to the bird known as the giant hummer (which may be as much as eight and one-half inches long), there are several smaller species.

Princess Helena's hummer is believed to be about the smallest, as well as one of the most beautiful. This tiny bird is only two and one-fourth inches long and weighs about the same as a dime. The plumage of this bird is a bright metallic blue-green above and satiny white beneath, with a brilliant red throat. Such a small bird would not need a very large nest, and Princess Helena's hummer builds one that is about three-fourths of an inch from side to side of the opening, about the size of a nickle.

Most hummingbirds are very good architects and they build very small, neat nests. They use plant down, held together with cobwebs and decorated with mosses, lichens, and sometimes feathers. The nests are usually saddled over a twig and look like a knot or a piece of bark curling off the twig. One species of hummer hangs its nest from the underside of a large leaf.

When the nests are built, the bird usually lays two small white eggs (some species lay only one). The eggs of our smallest of hummers, Princess Helena's, are the size of a small bean. The baby bird that hatches from one of these tiny eggs is about one-fourth inch long and, in spite of its small size, keeps both parent birds busy gathering the great amount of food it needs. The parent bird gathers insects and nectar that it partially digests and then feeds back to the baby bird by thrusting its bill into the tiny throat of the young bird and pumping the food down. This is repeated many times a day.

The bills and tongues of these birds are especially fitted for gathering nectar and insects. Some of the larger hummers have bills as long as five inches and a tongue that can be extended much farther. The tongue acts as a siphon, like a soda straw, and is used to suck up the nectar. Some of the bills curve down in one-third of a circle. Hummingbirds with this type of bill are called sicklebills. Other species have bills that curve up. Most of the bills are straight and are usually opened only to get food, as these tiny birds have feeble voices.

Many hummingbirds chirp or twitter, but the vervain hummer, which lives in Jamaica, has a sweet but weak song. It perches on a high tree and warbles for fifteen or twenty minutes without stopping. Other hummingbirds combine songs with weird stunts in the air. Costa's hummer will dive perhaps 150 feet and make a noise like a screaming bullet as it goes faster and faster until it almost reaches the ground, and then it rises to repeat the strange dance.

Good things are said to come in small packages, and in the family of small, brilliant birds we call hummingbirds this is certainly true.

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Seventh of a Series on  
SMALL LIVING THINGS

## SMALL MAMMALS

*by*

NANCY WORSHAM

*Raymond Foundation*



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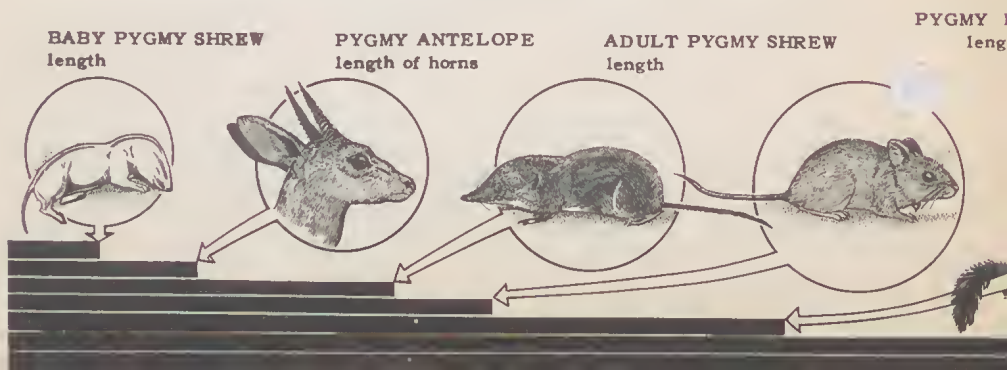
## Small Mammals

There are many small mammals living all around us. Most boys and girls know squirrels, rabbits, chipmunks, mice, and bats. These are all small, but they are not the smallest mammals. Even the pygmy mouse, only two and one-half inches long, is not the smallest.

The smallest living mammals are the shrews. Though they live in nearly every section of the world, they are not often noticed because they scurry around quickly under the fallen leaves and dead logs or in the deserted runs of mice and moles (few of them dig their own dens). What they lack in size they certainly make up in activity. They are always busy searching for food, hunting worms, insects, snails, and slugs. They will even attack mice or small birds. Shrews have sharp claws and teeth, which, with their agility and ferocity, make them worthy opponents for animals much larger than themselves.

Shrews give the impression of being extremely nervous animals. Even when they are not running around in quest of food, their long, slender noses are still quivering, as if trying to scent another meal. Their constant interest in food is necessary because if they do not have a meal every half day they starve. Hence they are active day and night the year around. Their only rest is in short naps after each meal. Shrews are protected from their main enemies, the hawks and owls, by their great speed, small size, and ability to hide in tiny places. They are distasteful to most animals because of their unpleasant odor and, although a cat may kill a shrew, it refuses to eat it.

Even among these smallest of mammals there are pygmies. One pygmy shrew lives in Europe, but it has a





smaller cousin in America. This smallest of all mammals is only about two inches long and weighs less than a dime. The babies of this species look like tiny, hairless, helpless, wrinkled, red honeybees. Half a dozen of them fit nicely in a nest smaller than a hen's egg. They grow rapidly to mature in six months, since their normal lifetime is less than a year and a half.

The names of many animals hint that they are smaller than most members of their families. For example, little pocket mouse, least chipmunk, pygmy rabbit, and dwarf shrew are all small animals. Some pygmies, however, are large when compared with these little animals. There are dwarf buffaloes, pygmy hippopotomuses, and two pygmy whales. The dwarf African buffalo stands three feet high. The common hippo is twice the size of its pygmy namesake, which is two and one-half feet high and weighs four hundred pounds. The pygmy sperm whale is from nine to thirteen feet long and the pygmy right whale, the largest animal in the pygmy class, is twenty feet long.

Many people think of the mouse deer as another example of pygmy animals, but it is not a true deer. Although it is about the size of a pygmy antelope, it is not in the pygmy class because it has no larger living relatives.

A group of small antelopes called duikers range in height from one foot to two and one-half feet. Royal or pygmy antelopes are smaller than duikers, only ten inches high, with tiny one-inch horns and legs the size of pencils.

Marmosets are small monkeys, about the size of squirrels. Like living toys, the pygmy marmoset sits only four inches high, dangling a five-and-one-half-inch tail. This tiny marmoset from South America weighs about five ounces or the same as a stick of butter.

MOUSE  
th

PYGMY MARMOSET  
height      length of tail

PYGMY ANTELOPE  
height



*This page is for your own notes and illustrations*

Eighth of a Series on  
SMALL LIVING THINGS

## PYGMY PEOPLE

*by*

EDITH FLEMING

*Raymond Foundation*



Museum Stories, Number 269

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## Pygmy People

On the other side of the earth, in the tropical forests of Africa, live the shortest people in the world, the Pygmies. The men are on an average only four feet six inches tall. Imagine a full-grown man only a little taller than a nine-year-old boy! The true Pygmy is a well proportioned grown-up, only he has never grown tall. He belongs to the Pygmy race and his children will be Pygmies, too. In the jungles of the Malay Peninsula and the Philippines are other short people called Negritos or "Little Negroes." These people are only a little taller than the Pygmies of Africa. They might be called Pygmies, too.

Long ago these little people covered a larger area and were many more in number than they are today. But because the Pygmies are small and their weapons are primitive, they have been forced farther and farther back into the jungle as the larger and stronger men who are farmers have taken the best land for themselves.

The Pygmies are hunters and food gatherers. In Africa the men poison the tips of their arrows so that even a minor wound will bring down the animal. The Negritos of the Malay Peninsula use poison, too, but they prefer the blowgun to the bow and arrow. The blowgun is made of bamboo, a long, narrow tube sometimes seven feet long—over two feet longer than the Pygmy is tall. The darts blown from this long pipe are made from the ribs of palm leaves, sharpened and dipped in poison.

The hunter does not wish to waste his darts; he takes careful aim. He holds his blowgun steady with no support, a very difficult thing to do. Then, puff! He blows out sharply. The dart is pushed out of the gun and, with good luck, hits the animal. The Pygmy's aim is good up to fifty yards, but farther than that the dart is likely to be blown out of line by the wind. The blowgun is so quiet that animals are not frightened by it. A monkey, who is always curious, will pull a dart out of its skin and look at it without running away. In two or three minutes the poison takes effect and the monkey falls to the ground.

The hunter cuts away the poisoned flesh around the wound made by the dart and the rest of the meat is safe to eat.

You would think that in the jungle, where plants grow very quickly, it would be easy to find a living, but this is not so. The Pygmies do not raise their own food. So they must eat whatever they can find, and much of it you would not like at all. The African Pygmies are very fond of boiled or roasted ants and caterpillars. The Negritos of Malaya are especially fond of durian, a large fruit that is good to the taste, but you would have to be very hungry to eat it because it smells like spoiled onions.

Each day the Pygmy women set out in search of food and dig up roots with sharpened sticks. But even by working very hard—the men hunting and the women gathering wild vegetables—they cannot find enough to eat. And so they trade some of the products of the forest, such as wild animals and honey, to their larger neighbors for other foods.

People who live on wild animals and plants must move their camps often. As soon as an area has been hunted out, or sometimes because of a whim, the Pygmies move to a new camp. At each new site, the women build a simple shelter, which they do quickly and easily because they do it so often.

The Pygmy life is full of hardships. The jungle is hot and humid, and there is danger from wild animals and discomfort from insect pests. Seldom is there enough to eat. So these little people are decreasing in numbers, and some day, perhaps, there will be no Pygmies left.

NEGrito OF MALAY PENINSULA



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